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# Strategic Developments in Collection Storage of Libraries and Archives – Architectural, Technical, Political

by HELEN SHENTON

## INTRODUCTION

Over the past decade there have been significant developments in the storage conditions of library and archive collections. These range from using the thermal mass of a building itself to help control the environment within which collections are housed, to increased attempts at creating sustainable, “green” buildings to adapting elements from warehousing and the retail sectors to manage daily operational tasks.

There is currently a considerable amount of collection storage activity going on world-wide. In Australia, two of the State Libraries and the National Library of Australia are designing new storage facilities, while in the United States the Library of Congress is building in two off-site locations. Denmark, after the recent cross-domain national Danish preservation strategy, is planning to spend several million Euro on storage for museums, libraries and archives over the next 5 years. The Deutsche Bibliothek is planning a new store in Leipzig, while the National Libraries of Canada and Sweden are also planning new storage facilities. In Britain, Oxford University Library and the British Library are planning new facilities; and Cambridge University Library is constructing a phased extension to its current building and exploring funding for a final phase.

Perhaps more important, there are significant developments underway that will affect the storage of library collections in the future. These include not only the architectural aspect of how collections are stored, but also the publishing perspective about the future shape of what collections are to be stored and the organisational perspective of who stores material in the future.

This paper makes some observations about trends in library buildings and trends in collection storage, and quotes examples of some recent building projects. Alternative storage solutions to actually constructing a building are considered. This is followed by observations of some developments that will affect what exactly will need to be stored, centring on trends in publishing and on research into the future shape of the publishing output to the year 2020, in both print and digital formats. This research is supported by expert views canvassed from international comparator libraries about their future collections. Brief mention is made of other professional and political developments that could have an impact on what libraries will be storing, such as collaborative storage. The current major building programme being planned at the British Library is used to illustrate recent technical developments, for example the adaptation of warehouse technology, the use of automated retrieval, fire prevention and fire suppression. Finally, mention is made of a couple of future possibilities, such as off-site robotic scanning.

## CURRENT LIBRARY BUILDINGS

What sort of library buildings is being designed? There is a lot of library building going on around the world - whether public, university or national. A great deal of thinking is going on about what library and information services comprise, with a blurring of boundaries. Some recent examples in the UK include the Norwich Public Library - a very painful fire was used as an opportunity to rethink the public library in the centre of a city and for the library to reinvent itself as a central feature of Norwich city urban life. The new library has an area at the front called “Express” that stays open until late every night and has explicitly modelled itself on the layout of a bookstore with titles displayed such a way that they can be quickly recognised. There is a blurring of the traditional public library and the retail sector - in this case, the contemporary bookstore. An example in London that has won architectural awards and acclaim is Peckham Library in South London designed by Will Alsop, which creates a public space below the main body of the library, and was intended to be part of the urban regeneration of the area.

The most recent developments to re-examine the future of urban public libraries are a series of Idea Stores, being designed in East London. The “idea” is to create a series of bright, new buildings in local shopping areas, combining lifelong learning and cultural attractions with all the services normally associated with libraries, from classic books to DVDs and CDs. The seven Idea Stores are being designed “to draw ... together ... the best traditions of the library movement and the education sector” and the retail and leisure sector. They are being “located in.. the heart of ..[the] neighbourhood shopping centres”. They “will become a focus for the local community with seven day a week and evening opening.” [1] Both the buildings that have already opened were designed by David Adjaye.

The use of signature architects is another noticeable trend in the development of library building. In university libraries, the revamped London School of Economics library in Holborn with its signature central spiral was designed by Norman Foster - who is also designing "The Brain", the Philological Library of the Free University of Berlin with "state of the art energy-saving system" (Werner & Diecks, 2004). In the United States, Frank Gehry is designing a building to consolidate Science and Engineering with the Library at Princeton University.

For university libraries, Klaus Kempf talked about hybrid library buildings with the advent of "collaboratories" and different learning styles and consequently the need for different "learning" zones, ranging from "quiet private areas" to "busy social areas with low-level seating and tables, and with refreshment facilities" (Kempf, 2004). It is noticeable in the recent LIBER Architecture Group papers, from which this quotation is taken, how often the importance of the informal area is mentioned for university libraries. This draws attention to the blurring of boundaries again, between library, and in this case coffee shop, and the above passage describes a place that is more akin to Starbucks within a bookstore.

The new Seattle City public library designed by the Dutch architect Rem Koolhaas underlines this trend. The brief to the designers was that it had been "calculated that the downtown Barnes & Noble bookstore had 40 times the people traffic, per square foot, as the old library. Why? What was the public sector doing wrong that the private sector is doing right? They want to compete" (Dietrich, 2004). The result is a very striking construction and in the very land of the coffee shop, one comment was "Is that a Seattle library or what?". "Never again will Seattleites be parted from their lattes" (Soto Ouchi, 2004).

National library buildings can be controversial constructions. The British Library opened around the same time as the Bibliothèque nationale de France towards the end of the last century, and just before the Black Diamond, Det Kongelige Bibliotek, on the waterfront in Copenhagen. These national libraries represent grands projets, major national cultural statements, with - and this is a key point - significant collection storage requirements that were not all satisfied on completion of these buildings, and all with significant future collection storage requirements.

## **CURRENT LIBRARY STORAGE**

There are ranges of solutions for storing collections, some of which involve building buildings; some of which do not and use, for example, outsourced private facilities. For institutional collection storage buildings, a comparatively recent trend has been towards high density, high bay, semi-automated warehouse-type facilities. Starting in the States in repositories such as at Harvard University (Kohl, 2003, pp. 244-246) and Yale University, it is currently being developed for Library of Congress's modular facility at Fort Meade, as well as at Stanford Medical Library, Berkeley, amongst others.

In Europe, this was used at the Bibliothèque nationale de France's Marne la Vallée site, and most notably the National Library of Norway's site in Mo i Rana in northern Norway just below the Arctic Circle. There are two library storage facilities at Mo i Rana. Firstly, printed and audio-visual media are stored in long-term storage vaults, which have been mined out of solid rock in the mountain. These mountain vaults contain four floors with 45 km of shelves, and the atmosphere inside is carefully controlled. They contain one copy of the Norwegian legal deposit material. Secondly, there is an adjacent building with high bay, high density automated storage for higher use material.

Characteristically this latter type of collection store borrows technologies from the warehousing sector, with semi-automated cranes, tall shelving, high density stacking systems in standardised containers, bar codes and automated warehouse tracking systems.

Any building project is a combination of people, place and process. A feature of this new style of facility is that the store is often distant from the main reading rooms, and broadly speaking they separate people from place and process, with attendant service implications. In the case of the national libraries, Marne la Vallée is about 80 km outside Paris; the Norwegian store is about 1000 km away from Oslo and the British Library is planning its new storage facility in Boston Spa some 325 km away from the St Pancras reading rooms. There are any number of reasons for these decisions - at the bottom of which are often largely economic ones. There are then consequential decisions to be made about the value and use of the collections to be stored and the environmental requirements, the service levels to readers and so on.

## **Alternative storage options**

While some libraries are constructing their own buildings, there are others which are not planning new building for their collection storage needs; they do not have the funds or their storage need is a short-term one. One solution is to rent outsourced, offsite, commercially-available storage facilities. Some of these outsourced options use underground stores,

for example, in the UK, salt mines in Cheshire or a stone quarry in Wiltshire. This is nothing new; in the 2nd World War paintings from the National Gallery and the Victoria and Albert Museum were stored in mines during the blitz in London.

It is a viable solution particularly for short term or medium term requirements. Apart from the cost benefit calculations about, essentially, “renting” versus “buying” storage, there are clearly crucial risk factors to be calculated with outsourced storage, for environment and security as well as significant access issues. The John Rylands University Library in Manchester is currently using the DeepStore salt mines for temporary storage of its collections during refurbishment of its buildings and the UK’s National Archives use the same mines for long-term storage of archival records (Bülow, 2004; Hodgson, 2004; Hopkins, 2004).

The British Library uses the option of underground storage at a stone quarry, as an interim, very short-term storage option for master negative microfilm. As a generalisation, it has been found that the costs of storage are comparatively low, while the costs of access are high, so one of the criteria for what is stored there is of necessity that it be low-use. The library was also once offered an underground nuclear bunker; however, following investigation it was discovered that the environmental specifications could not be met.

Another interesting model is being developed in the Netherlands by a company called [Helicon Conservation Support](#) who are planning a facility called Cultures Keep, which, to quote from their literature will be “a shared storage facility, built specifically for “optimum storage and preservation of cultural heritage” in the Netherlands. It separates out public functions for security; it has low oxygen for fire prevention and pest management; there are no sprinklers for accidental water damage; there is automated chip-technology system for registration and tracking etc. Indications are that one company is building the building, another company is offering a conservation storage operation; and public sector collections are the anticipated clients.

## THE FUTURE SHAPE OF WHAT IS TO BE STORED

Institutions providing storage for library stock in the future have to take account of the format and size of the collection materials and decide the balance of emphasis between paper printed materials for the medium term, for example, or putting resources into digital storage and digital archiving.

To make the case to government for the new storage-building programme for the British Library, research was carried out to address the question of what the Library would be collecting in the future. The expectation of the government, of the Department of Culture, Media and Sport (the sponsoring ministry), was in many ways that it would all be digital. This engendered the “flip-over” point debate - at what point would the majority of material change over or “flip over” from being predominantly paper-based printed material to predominantly digital and e-published?

The Library commissioned research into predictions of publishing trends to 2020 for the UK and for overseas publishing output, including long-term projections of the growth rate for electronic publishing. To test these predictions the expert professional view of the directors of comparator libraries around the world was sought. These institutions included the national libraries of Germany, France, Australia, the Library of Congress, Yale and Harvard, who all responded with opinions on the suitability of digital as a long-term preservation archival surrogate for print and on their anticipated storage needs based on their collecting projections (Shenton, 2004).

The headline findings of the research into projected publishing trends to 2020 were:

a. In terms of volume or amount of material:

- annual output of UK monographs will increase by 100%
- ie by 2020 there will be twice the number of books produced than in 2003.
- annual output of UK serials will increase by 70%
- ie by 2020 there will be nearly three quarters again of periodicals, journals
- Overseas publishing output will increase at up to 5% per year between 2010 and 2020

b. In terms of the format of the material,

- currently 65% of serials are hybrid
- i.e. they are published both on paper and electronically
- by 2016, 50% of serials will be solely in e-format

- ie for half of all serials there will be no paper version published.
- by 2020, a quarter of newspapers will be only in e-format, with virtually none solely in print.
- by 2020 40% of UK monographs will be e-format only.

In conjunction with the publishing trends research, the British Library sought the views of the directors of 16 major international libraries in Europe, North America and Australasia (of which 12 were national libraries and 14 had legal deposit responsibilities). They were asked to address the following three questions:

1. What is your expert view of the suitability of digital as a long-term preservation archival surrogate for print where the identical content is available in parallel formats?
2. If content is available in parallel formats, do you currently choose to keep the print format or the digital format or both for preservation purposes?
3. In your expert view, do you foresee this situation changing in the next five years?

In answer to question 1 the general consensus was

- Digital is not generally viewed as a suitable long-term preservation archival surrogate for print; it is currently regarded more as an access medium.
- As a long-term preservation medium, digital was generally seen as unstable, experimental, immature, unproven on a mass scale and unreliable in the long-term.
- It is not generally viewed as a long-term preservation medium due to a variety of reasons that are not just technical, but range from legal, political, strategic, financial, managerial and organisational to the availability of appropriate skills.

The second question asked if content was available in parallel formats does the institution currently chose to keep the print format or the digital format or both for preservation purposes. The responses showed that:

- Just under half were choosing to keep both formats for preservation purposes,
- Just under half were choosing to keep print only.
- One was currently choosing to keep digital only.
- Collecting and storing print formats is currently seen as insurance, particularly for legal deposit libraries.

The National Library of Norway said: "We keep both. The life span of the material will be dramatically longer if you keep it under the climate conditions that are present in our storage vaults (35% RH, 8° Celsius, enough air-change, different filters). Actually: some material (magnetic tapes) have proven to be in better condition after 5 years of storage in the vaults than it was when we initially received it."

The one Library that does currently choose to keep digital only, the Koninklijke Bibliotheek (KB) in the Netherlands, said: "The KB adheres to a very simple and strict policy. In the case of parallel formats we collect and archive the digital version only. We have already started cancelling the paper versions of scholarly journals. We are strongly committed to safeguarding permanent accessibility of digital information, particularly electronic scholarly journals. We introduced this policy, in order to demonstrate our commitment, to force ourselves to take this commitment very seriously and to increase cost effectiveness. However this does not mean we no longer need traditional stockrooms. Actually we have just started building new stockrooms as an annex to our premises. The reason is that the flow of single format, printed material for the national deposit collection is not diminishing, at least not yet."

Question 3 asked if in their expert views the directors foresaw this situation changing in the next five years. There were mixed responses:

- There was the opinion that the flip over from predominantly print to predominantly digital would happen within the next five years, due to increased digital publishing, pressure on storage space, and increasing confidence in digital preservation.
- There were predictions of change but these were dependent on critical factors such as investment by the computer industry, more managerial and financial experience of digital archiving within institutions, more proof that digital and print manifestations are identical, and investment in digital infrastructure.
- There was also scepticism after repeated prophecies of change.

- Overall, it was found that firstly all libraries are experiencing a growth in printed collections [they had been asked to quantify this and is collated in the research] and all are continuing to make additional storage provision for this growth; secondly the preservation of the print publication as ‘artefact’ is becoming an increasingly important factor, whereby the look and feel of the print format has intrinsic value for future research; and thirdly safeguarding the authenticity of the national published output for legal and research purposes are reasons for collecting and retaining the print format.

The international comparator findings therefore concluded that in the short term, there is a need for physical storage. Even the KB that made the momentous decision to collect only the electronic version of Dutch legal deposit material from 2003, is planning 24 km of physical storage of 4000 m<sup>2</sup> to accommodate 15 years projected growth at a cost of Euro 8.2 million.

## PROFESSIONAL AND POLITICAL DEVELOPMENTS

There are a multitude of political developments, strategic developments and conceptual developments that may shape what libraries will be storing in the future. These range from collaborative collection development; rationalisation; disposals and deaccessioning; and collaborative collections consortia, such as in [CASS](#), the Collaborative Academic Store for Scotland and in England, the [White Rose](#) University Consortium (the British Library and York, Sheffield and Leeds University Libraries) about the potential for collaborative storage. What has been termed “deep resource sharing”, the open access movement within academia, are all developments that are and could impact on who is storing what and lead to the question - do we all have to store it all ourselves?

University libraries and the national libraries are debating the role of institutional repositories, in both the digital and the print arena. The higher education libraries are looking to the national libraries to be, to use the term in the BL Act of 1972, “the library of last resort” but there is an expectation that national libraries will increasingly be the library of “first resort” as well. The [Research Information Network](#) (RIN) is being set up to advance this. The RIN’s role is to provide strategic leadership in relation to the provision of research information in the UK. It is sponsored by the four UK Higher Education Funding Councils and the three UK national libraries, and will address strategic issues, amongst others, of retention and storage. [CURL](#) has commissioned research into collaborative storage.

## RECENT AND FUTURE TECHNICAL DEVELOPMENTS IN STORAGE

At the British Library, a major storage programme is underway. The case has been made to government, partly based on the research described in this paper, and the library has received two tranches of funding for storage buildings with a challenging timescale. The British Library’s St Pancras building stores about half of the BL’s collections. The principle is that the high use material and the high value material is stored at St Pancras while the rest of the collections are stored in buildings around London and in Boston Spa in the north of England. The BL property strategy is for any new building to be on the Boston Spa site as it is substantially less expensive than building in London. The strategy envisages any new building supporting an increase in the percentage of collections in satisfactory environmental conditions, ie British Standard 5454-2000 (BSI, 2000), so that any move of collections should result in the collection items being in better storage than they were in before. A move should maintain - and improve where feasible - service standards to users, and it should constitute a sustainable facility and deliver additional storage for the best value for money.

The reason for the building programme is that the British Library will be operationally full in 2006/7 and that the collection grows by 12 linear kilometres per year. Many options have been investigated. One of the main imperatives was to design the maximum amount of storage on the minimum footprint. The result is a plan to build a high density, fully automated store to accommodate 260 linear kilometres of low use, primarily printed collection material at Boston Spa.

The British Library is planning the new storage building by separating out “people” and “process”, so, using warehouse technology the collections will be stored in containers, two containers deep on shelves. The shelving will be c.20 metres high. Fully automated cranes, travelling up and down the aisles, directed remotely by a warehouse management system, will retrieve the containers. Full automation means storing the books in containers or totes - and the size and material of totes is critical as the container is the building block around which the whole operation is sized and designed. The automated cranes will deliver the containers onto a conveyor belt that then moves the books to a separate area where people will remove the individual item from the container.

Basically this is the way in which people and collections can be separated. The storage environment can be specifically suitable for the collections. There is no light - it is literally a "dark store" - and so the risk of damage to the collections from photo-catalysed oxidation is reduced. The risk of damage from UV is minimised. The heat from light is minimised which helps the cost of the air handling.

When the designers investigated fire suppression systems, the achievability of having sprinklers in such a facility, and the cost, became issues. In warehousing a fairly recent development is the use of lower oxygen levels as fire prevention as an alternative to sprinklers and misters being used for fire suppression. The basic principle is that a lower oxygen environment will not support ignition and so prevents fire starting in the first place. The concept is to hold the storage environment at 15% oxygen. The air we breathe is about 20% oxygen. 15% oxygen does not support ignition. Paper does not burn at these levels - it smoulders but does not support a flame.

The principle of low oxygen for fire prevention is used in the nuclear and defence industry. British Library staff visited a number of retail and technological facilities around mainland Europe that have this system. For example a clothing manufacturers' warehouse in Stuttgart, which is fully-automated and equipped with high bay storage of the rolls of cloth. Since the warehouse is fully automated, no people work in it. The facility is run at between 14 and 15% oxygen. This is the equivalent of being at an altitude of 3000 metres. However it is possible to work in it, if necessary - European legislation varies between six hours and four hours per day. One of the few libraries that has this system currently is the Special Collection Library at Groningen University Library in Holland which is run at 15% oxygen level as a retro-fitted alternative when the gaseous fire suppression system became illegal, due to changes in legislation.

Low oxygen storage has been used in various ways in cultural institutions for a number of years. The National Archives and Records Administration stored the Declaration of Independence first in helium in the 1950s and now argon. Anoxic or low oxygen environments are used in museums for deinfestation of, particularly, ethnographic collections.

There is a potential preservation dividend with storing at lower oxygen levels, not fully proven yet so far as is known. The BL visited IT facilities where nitrogen can also be flooded into the building as back-up fire suppression, should the unthinkable happen and there be a fire. Low oxygen is an active system, being constantly monitored, as opposed to a passive sprinkler system that is proven to work only in an emergency. The air tightness of the building is a major issue with low oxygen environments - and the process of retrofitting it into a building could be considered more difficult for that reason. The British Library will have duplicate generators, and there is also a 90 hour buffer of the 15% oxygen levels.

The proposed new store will be a single climatic zone with one environmental specification. An outstanding need for the British Library will be cold storage for, amongst other things, its cellulose acetate microfilm collections. One of the conclusions of the Cellulose Acetate Microform Forum, organised by the BL and the LIBER Preservation Division in May 2005 is that there are no cold storage facilities across the UK in the way that there are in the US. [2] The potential need for cold storage in the UK is being scoped by the British Library as part of the International Roundtable on Microfilm.

## **FUTURE DEVELOPMENTS**

It is a truism by now to say that often the single most effective action that can be taken to look after a collection is to improve the environment in which it is stored. Whilst the importance of stable environmental conditions is generally recognised as a method of slowing the deterioration of our - largely organic - cellulose collections, there have been changes over the past years in how those stable environmental conditions are achieved.

Alternatives to high maintenance, high cost air conditioning systems have been sought with sustainable, low-maintenance ways of achieving a stable environment. The National Archives in Canada Gatineau building in Ottawa uses land mass around the building as thermal inertia. One outstanding low tech example is the Imperial Palace Archives in the centre of Tokyo. In the height of summer, when the outside relative humidity can be 95%, the archives are a very steady 55% RH. This is achieved, not with air conditioning, but by lining the walls with cedar wood planks butt-jointed along the walls, not fixed, with room to expand and contract. They maintain the even humidity within, coupled with individual paulownia wood boxes for the scrolls. The cedar wood not only evens out the RH but is also an insecticide - and suffuses the whole archive with the most delicious aroma.

More prosaically the British Library looked at the possibilities of berming or semi-berming for the new storage building, that is, fully or half covering the building with earth. An environment without air conditioning would mean that the temperature in summer would have risen to 35°C. Sustainability, greening, environmental impact assessments, low

energy and energy-efficiency are relatively recent economic and political imperatives that are now being incorporated into library storage design.

Collection storage is not just about storing collections. In preparation for a move, a lot of opportunistic cleaning and stock maintenance and housing are already underway in the British Library. The planning and management of the move is a colossal undertaking - early estimates are that it will take a minimum of 18 months to accomplish.

### **Automation**

With automation, bar codes are used or increasingly in the retail sector, radio frequency identification (RFID) tags can be used. The Vatican Library is using these already. In fact there is interest in RFIDs from not just the security and tracking angle, but also from the book industry, and cataloguing. The predictions seem to be that RFIDs will be seen in libraries and archives after they have become cheap enough to be used on low value items in the retail. In the US Walmart has recently ordered all its supply chain to use them, and in the UK, Tesco is experimenting with RFIDs on expensive goods.

The current automation options involve either a person in a crane being hoisted to a container of books on a shelf and the person picking out the book, or, a container of books is automatically retrieved from a shelf and put on a conveyor belt and delivered to a person elsewhere who then takes out the required volume. The next step for automation would be for a robotic arm to take an individual book off a shelf, an idea being developed at Johns Hopkins University. The vision is for one robot to retrieve the volume in an off-site store, take it to a scanning station, where the volume is scanned with the pages turned automatically by another machine, for instantaneous digital relay to the reader who is 30 miles away on the main campus or is at their laptop at home.[3] There are already automatic page-turning scanners on the market. Further development could come from research, such as that at Leeds University, looking into scanning a book without opening it, using terahertz imagery.

### **CONCLUSION**

When predicting future collections, it is not a question of storing either digital or print but for the foreseeable future, both formats require storing. Collection storage solutions are borrowing from the retail, warehousing and supermarket sector. Library management is adopting the warehouse technology of prefabricated construction and shelving at the core of the superstructure and adapting retail technology of bar coding, process flow, automation, RFIDs, low oxygen – high nitrogen environments used to store apples and other perishable goods. It could be said that the examples used in this paper have more in common with IKEA, supermarkets and “just in time” distribution centres than traditional library buildings.

### **NOTES**

1. A Library and Lifelong Learning Development Strategy for Tower Hamlets. A joint accommodation strategy developed by the Customer Services and Education Directorates for the Arts, Leisure, Sports and Youth and Community Services committees, April 1999. Information updated as at January 2002. <http://www.ideastore.co.uk>
2. *LIBER Quarterly*, Vol 15 (2005) No. 2 contains the papers from the Cellulose Acetate Microfilm Forum, held at the British Library, May 2005. <http://liber.library.uu.nl/>
3. Comprehensive Access to Printed Material (CAPM), Johns Hopkins University, [www.dkc.jhu.edu/CAPM](http://www.dkc.jhu.edu/CAPM)

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#### **WEB SITES REFERRED TO IN THE TEXT**

CASS, - the Collaborative Academic Store for Scotland. <http://scurl.ac.uk/projects/cass/>

CURL. <http://www.curl.ac.uk/>

Helicon Conservation Support. <http://www.helicon-cs.com/engels/index.html>

RIN - Research Information Network. <http://www.rln.ac.uk/>

White Rose University Consortium. <http://www.whiterose.ac.uk/Home.aspx>